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GB 1363702 GB 1327231 GB 1276184

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(54) Refractive optical element

(57) An optic V is provided having an overall optical effect equivalent to: a plurality of optic elements 80,81 and/or 83,84 in side by side relation, each optic element having a light dispersing means and having at least one optical surface e.g. having crossed cylinder optical effects including the composite effect of a first cylinder disposed along a first axis and a second cylinder disposed along a second and intersecting axis. The optic is normally transparent. The first and second cylinders may be formed on the same or respectively on two sides of the optic.

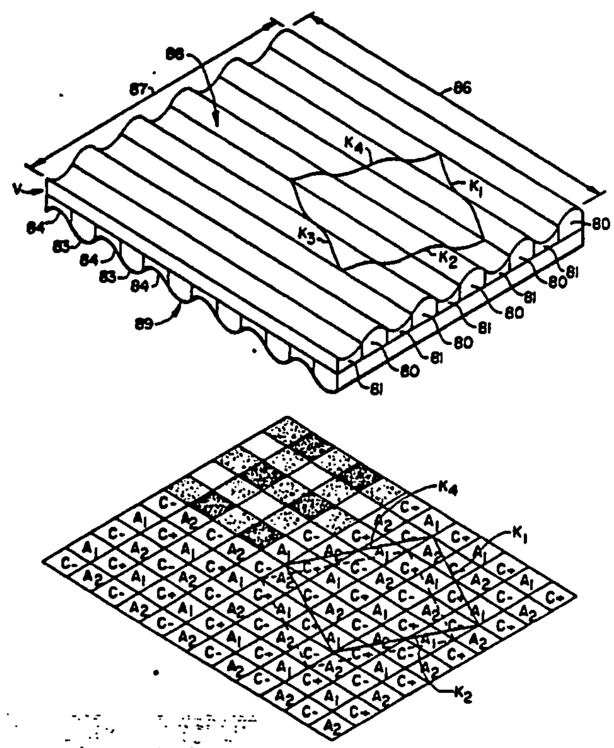

Fig.1.

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

The date of filing shown above is that provisionally accorded to the application in accordance with the provisions of Section 15(4) of the Patents Act 1977 and is subject to ratification or amendment.

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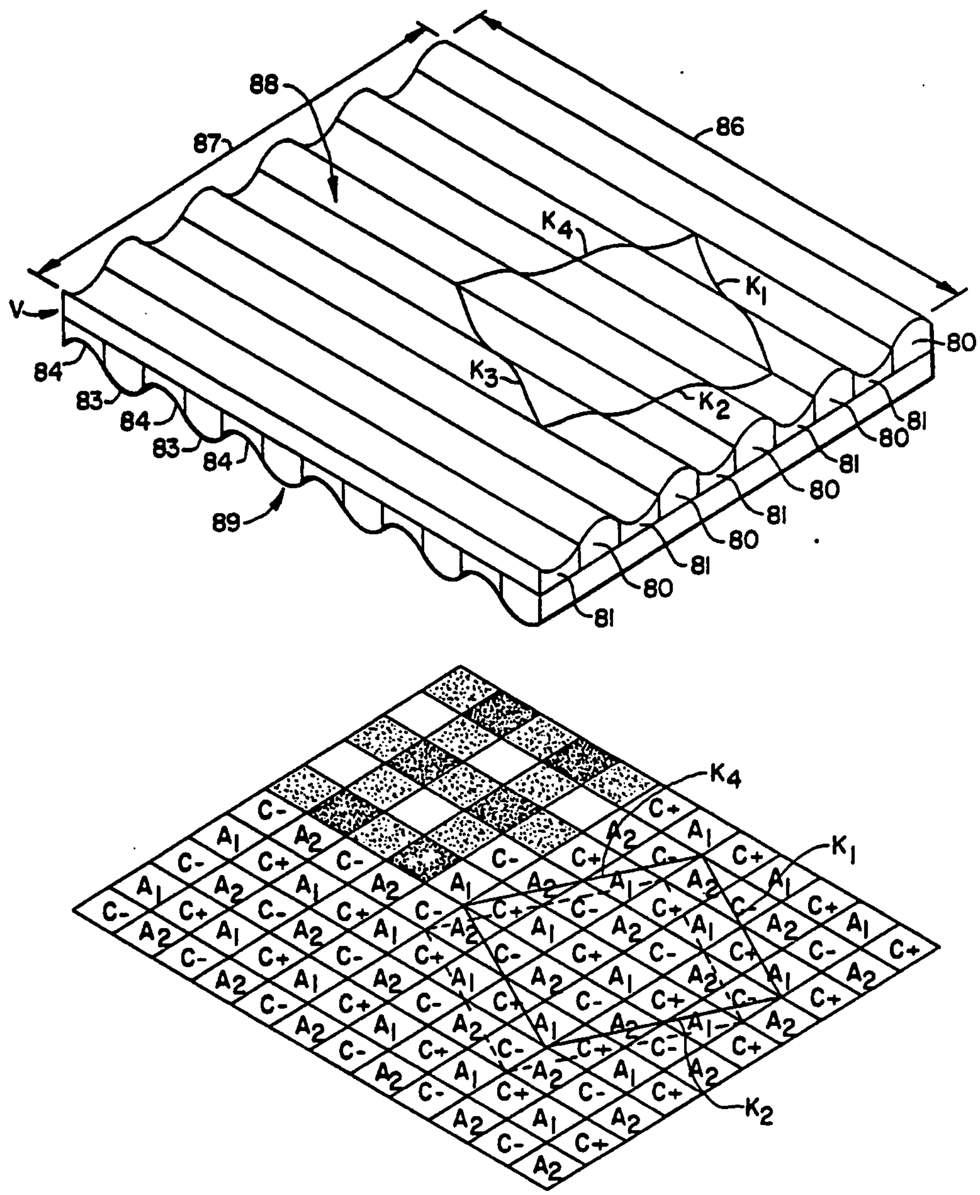

Fig.1.

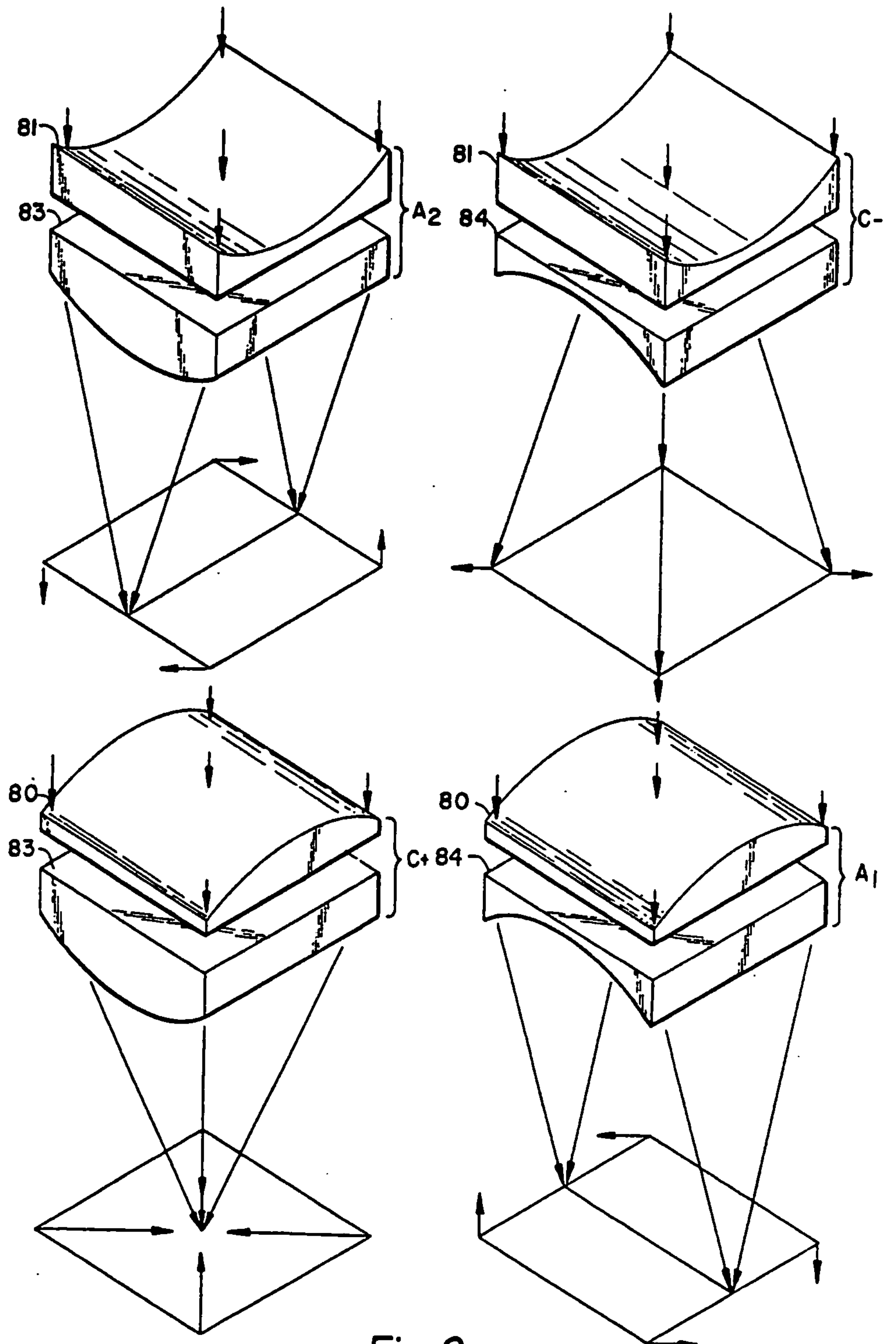

Fig.2.

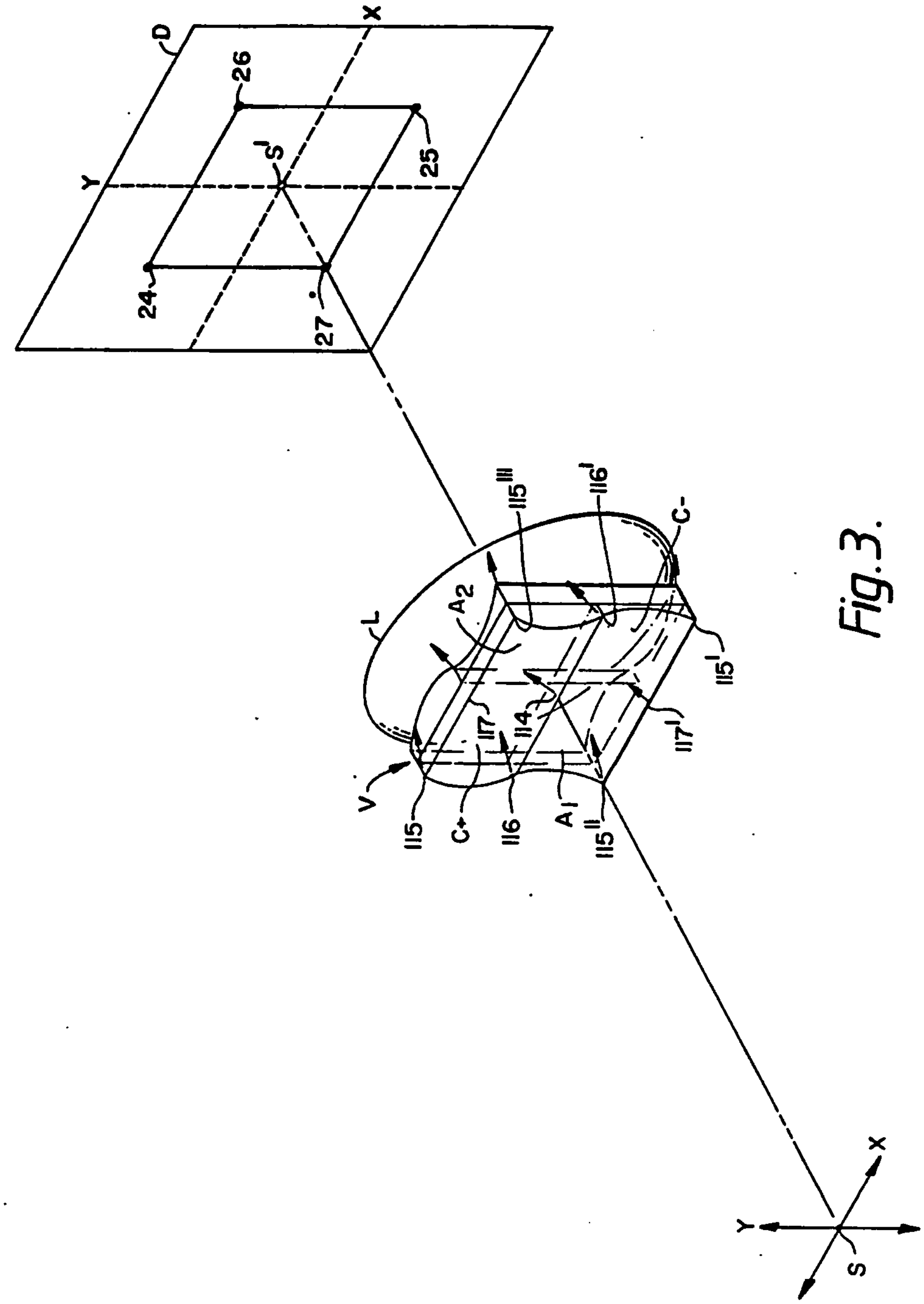
D
X
Y
24
25
26
27
S'
L
V
A2
A1
C+
C-
114
115
115'
115''
115'''
116
116'
117
117'
X
Y
S

Fig.3.

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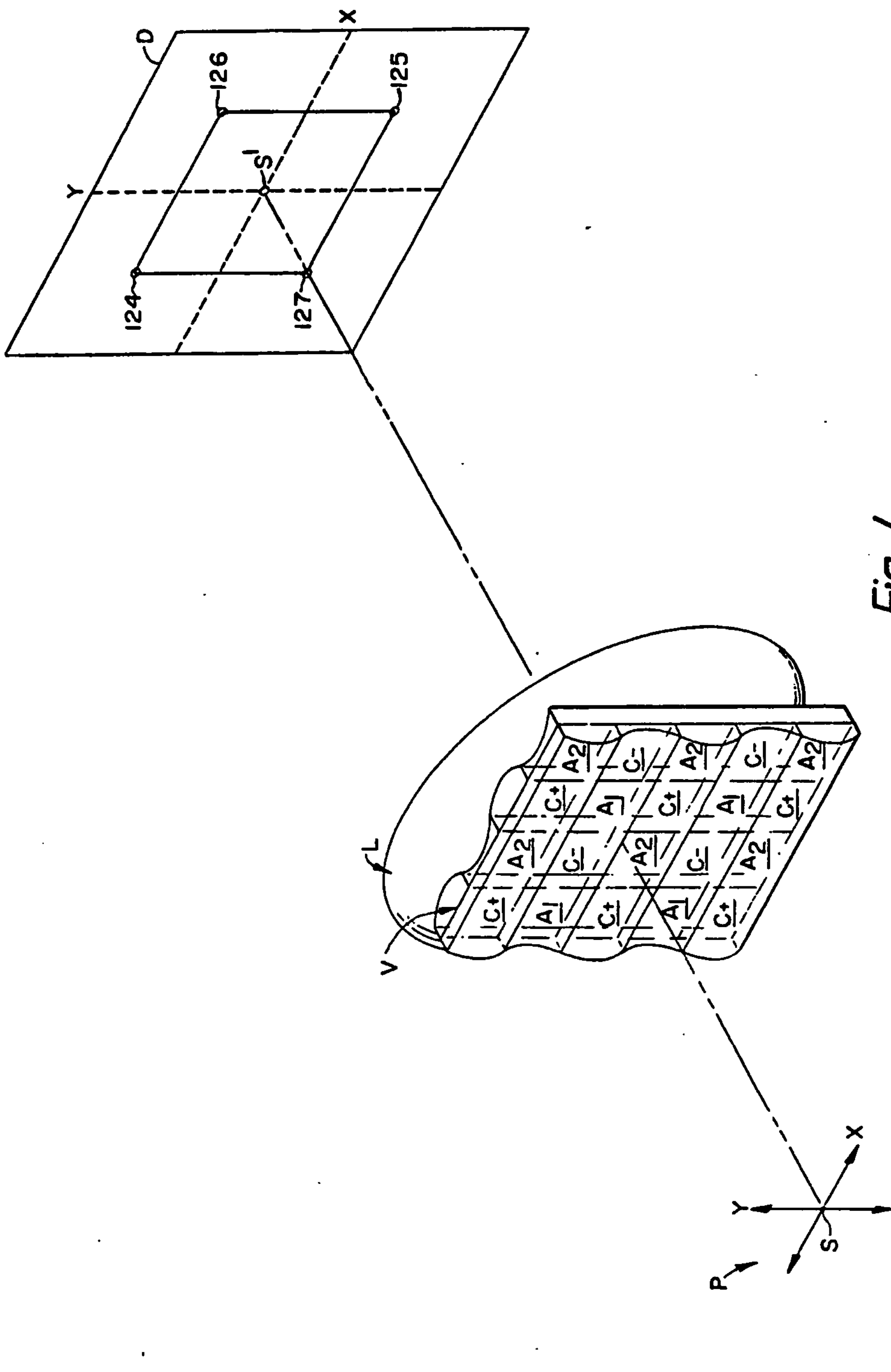

Fig. 4.

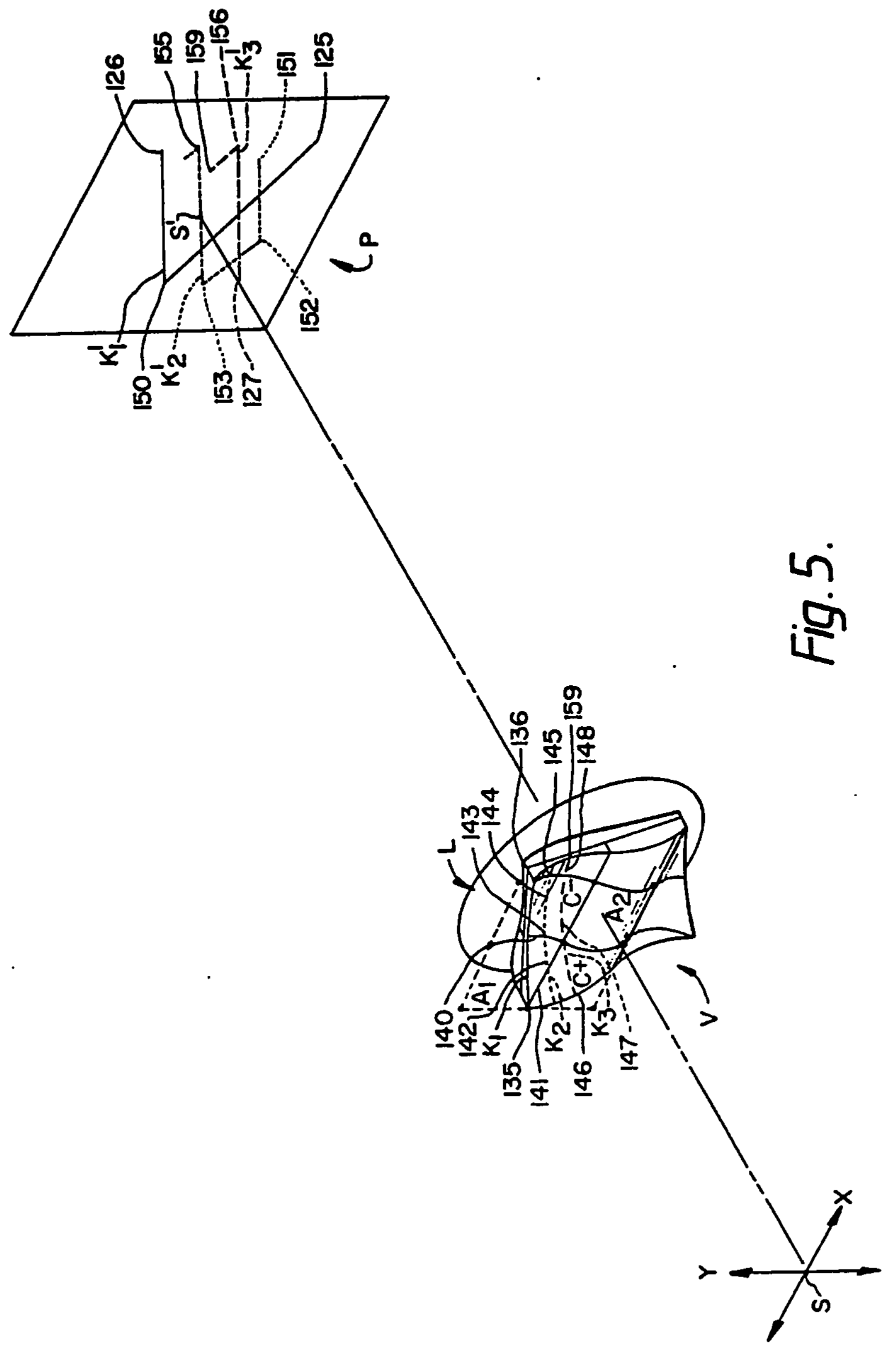
126
155
159
156
K'3
151
125
S'
P
K'1
150
K'2
153
127
152
L
143
144
136
145
159
148
C−
A2
A1
C+
140
142
K1
135
141
K2
146
K3
147
V
X
Y
S

Fig. 5.

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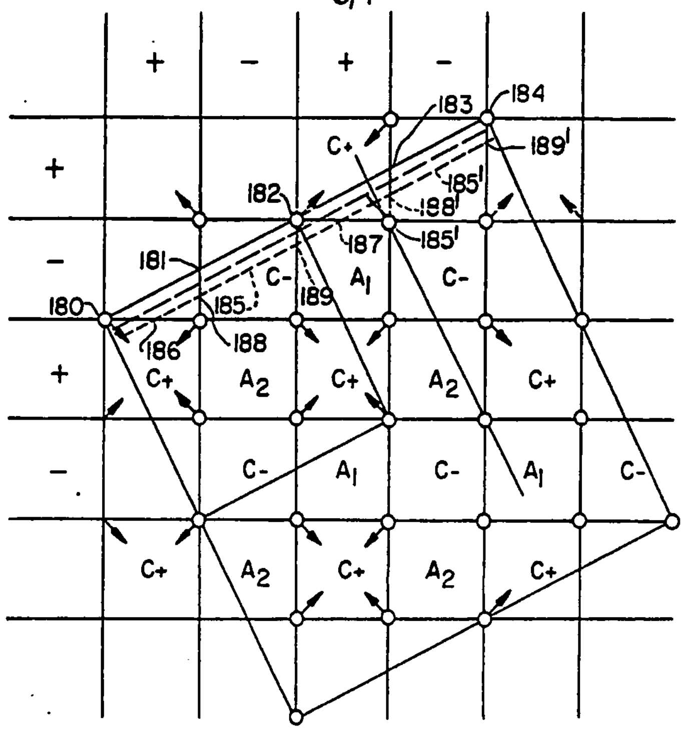

Fig. 6.

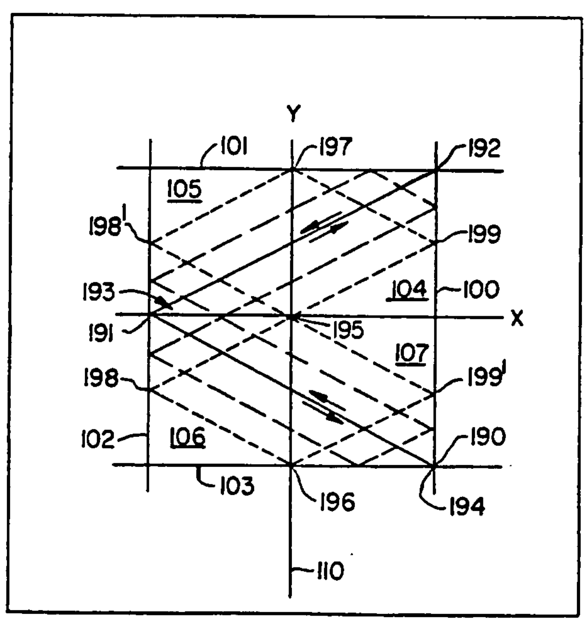

Fig. 7.

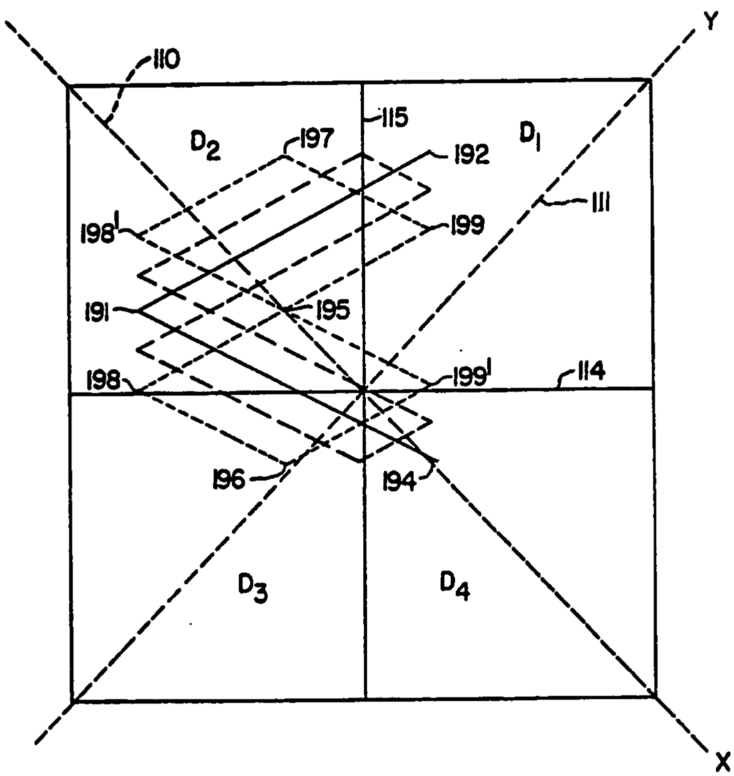
Y
110
115
D2
D1
197
192
198'
199
111
191
195
198
199'
114
196
194
D3
D4
X

Fig. 8.

SPECIFICATION

Optics for the deflection of light

The invention relates to optics for the deflection of light, and their use in objective refractors for the eye. Such refractors are described in our Patent Specification No. 2 086 609A, to which reference is directed.

Disclosed herein is a class of image dispersing optics, which optics may be utilized for the displacement of light with optical detectors preferably of the discrete photoquadrant variety. An optic matrix is generated having an overall optical effect that may best be described using lens optics of the cross cylinder variety. A first group of cylinders (of either positive or negative power) are laid in a first direction to in effect generate a first light deflective effect. A second group of cylinders are laid in another direction (preferably at right angles) and disposed to generate a second light deflective effect. The cylinders used may be chosen from pairings which are positive and positive, negative and negative, or positive and negative (regardless of order). There results an overall matrix of optical elements, which matrix of optical element causes distribution of light to each of the quadrants of photo-discrete detectors. The greater the number of discrete elements, the less critical the alignment of the lens elements with respect to a knife edge becomes. For example, where a large number of randomly placed elements is used, the need for precise alignment of knife edges with respect to the elements disappears altogether.

Other configurations of lens elements are possible that will serve to distribute light among photodiscrete detector segments in proportion to the displacement of low intensity images. By way of example, conical and randomly aligned prismatic segments all have an effect which can be used with the photodiscrete detectors described in our Specification No. 2 088 609A referred to above.

As described above, cylindrical lenses of positive and negative power can be used. These cylinders are laid in side by side disposition. Along one side of the lens positive and negative cylinders are aligned in a side by side array. Along the opposite side of the lens positive and negative cylinders are aligned in a side by side array at preferred right angles to the first array. There results a matrix of crossed cylinder lenses, including positive sphere, negative sphere, cylinder in a first orientation and cylinder in a second and 90° rotated direction. This specialzed lens has the advantage of dispersing light evenly in a pattern not unlike that generated by the trace of various Lissajous figures. An advantge of this lens is that when it is combined with a knife edge cutting across the lens matrix, the knife edge at the boundary can generate symmetric patterns for detection. These patterns evenly distribute light over a given area, which distributed light may then be detected to photodiscrete detecting elements.

Utilization of knife edges with the matrix of cylindrical lenses means that the electrical signal out from the detector is directly proportional to the intensity of the image and the image displacement. Moreover, extremely low light levels can be sensed. Segments of the photo-sensitive surface can all be electrically isolated one from another.

A particular advantage of the above arrangement is that the overall projection system required for the detection of light is shortened. Consequently, this projection system lends itself to compactness in the detector.

An embodiment of the lens elements may be used in front of a four quadrant detector. According to this aspect, negative lens surfaces are distributed in side by side random relationship over an optical surface, preferably a refractive surface. Specifically, these surfaces are of random alignment and closely spaced. An easily constructed lens element results. For example, it has been found that by utilizing a positive mold, such as a ballbearing impressed upon an optical surface or replicating media for an optical surface, one obtains a perfectly satisfactory optical element.

A further advantage is that the diclosed randomly made optical surface or 'pebble plate' does away with the need for precisely aligning the knife edge with respect to an axis of the plate. Instead, both the pebble plate and the optic elements utilized with it can be randomly placed one with respect to another.

When using a matrix of cylindrical lenses in combination with a knife edge, light from the knife edge is projected through the specialized optics to the eye and light received from the eye passes again through adjacent portions of the specialized cylindrical lens. There results in the passage of light to the eye a Lissajous-like dispersement of light along the knife edge. Consequently, only a portion of the light so projected can be seen over the knife edge. The remaining portions of the light projected to the eye from the knife edge are not returnable to the detectors as the physics of the knife edge test renders these rays not visable. The portion seen over the knife edge images back to a position immediately above the segment of the cylindrical matrix from which projection originally occurred. At this segment of the lens a complimentary deflection of the light occurs. There results an enhanced displacement of the light.

An advantage of this aspect of the invention is that the physics of a knife edge test is used in combination with the predictable dispersion of light at the knife edge to screen out all that light, save and except that which has a de-

sired projection angle which can be seen upon return. There results a low level light signal of enhanced sensitivity returning from the eye. A further advantage is that the returning light hits a segment of the cylindrical matrix lenses, which segment produces a complimentary deflection. This complimentary deflection not only further deflects the light but produces an image center of gravity which is an enhanced, and improved signal.

An emboidment of the invention will now be described by way of example and with reference to the accompanying drawings wherein:

Figure 1 is a perspective view of a cylindrical lens matrix with an underlying schematic drawing for explaining the function of the lens;

Figure 2 is a diagram of illustrated segments of the cylindrical lens, this diagram illustrating respective segments of positive sphere, negative sphere and two components of astigmatism along opposite axes;

Figure 3 is a perspective illustration of a four element lens projected by a spherical lens system from a light source to an imaging plane;

Figure 4 is a perspective similar to Fig. 3 illustrating multiple lens segments;

Figure 5 is a perspective view similar to Fig. 4 with three knife edges disposed at an angle over the face of the lens element; and

Figures 6, 7 and 8 are respective representations of lens elements and resultant images on detecting planes of a plurality of knife edges disposed over the lens element;

Fig. 1 illustrates the preferred lens array and preferred knife edge, and will first be discussed illustrating the make-up of a lens utilizing Fig. 1. Fig. 2 illustrates the optical characteristics of each of the lens segments.

As shown in Fig. 1 lens V consists of a series of side by side cylindrical lens strips. Positive cylindrical lens strips 80 have inserted intermediately negative lens strips 81. These strips 80, 81 alternate in side by side relationship with the lens strips themselves extending along the width of the lens parallel to arrow 86. Together the side by side lenses make up a first half of the lens generally denominated as 88.

A second and lower half of the lens 89 consists of side by side positive lens strips 83 and negative lens strips 84. As was previously the case, the side by side strips extend across the lens parallel to the dimension arrow 87 and formed together the second side of the lens 89.

The reader will realize that the lens here illustrated has been shown of composite make up. In actual fact, the divisions between the clylindrical segments 80, 81 and 83, 84 are not visible. Typically, the entire lens is fabricated from moulds and is made up of a uniform optical material which can be impressed with the desired shape, such as a lens plastics. The optical element may also be fabricated with one flat surface and an opposite composite surface having the desired deflections herein described. Having set forth the make up of the lens with respect to Fig. 1, the optical effects of the underlying matrix will be set forth with respect to Fig. 2.

Those having skill in the optical art will be aware that two cylinders of equal powers set at right angles one to another can combine to be the equivalent of a spherical lens.

Looking at a first segment comprising cylinder segments 80, 83, it will be immediately seen that a positive spherical lens effect C + results from the combination of the cross cylinders. Conversely, and referring to crossed negative cylindrical lenses 81, 84 the crossed negative lenses results in a negative spherical lens effect C −.

Combinations of crossed positive and negative cylinders have an overall cylindrical effect. In this way, it will be seen that segments 80 and 84 at the juncture where they cross form a combined crossed cylindrical lens A_1. Similarly, crossed negative and positive cylinders 81, 83 form a combined cylindrical lens A_2.

Stopping here and referring back to Fig. 4A it will be seen that each of the discrete lens segments can now be labeled. They can be labeled according to their power. As the pattern in Fig. 2 is repetitious, such labeling of a small portion of the matrix continues throughout the entire lens.

Returning to Fig. 2, various parallel rays in their passage through discrete lens elements have been illustrated as deflected. These illustrated deflections of light can be used to generate a vectorial description of lens deflection.

Referring to the illustrated lens deflections, it will be seen that each lens segments shown in Fig. 2 has arrows drawn in the corners of a figure, which figure is a projection of the area of the segment. These arrows can be seen to be descriptive of deflections produced. They will hereafter be used to describe deflection produced by the lens.

Referring to Fig. 3, a point source of light S projects light through a spherical lens L to an image plane D. For all points within the system, the light will again project to a centre point S' on the image plane D.

When the plate or lens V is inserted a matrix of four side by side lenses is created. Only one such matrix of four lenses is illustrated in Fig. 3. In the preferred embodiment this matrix is repeated many times.

Denominating the respective segments, the designations C+ ,C − are used for the respective positive and negative spherical lenses. Likewise, designations A1 and A2 identify the astigmatic segments of the lens.

Remembering that all points S when imaged through lens L converged on the points

S', consider what happens to rays passing through neutral points of the lens segments C+, C1, A1 and A2. In each case, we find that the rays against must end up on the point S'. The deflection of the remaining rays is less clear.

Vector descriptions can be developed with respect to Fig. 1 to describe the deflection of light. This vector description can be made for each of the lenses about its neutral point. It is possible therefore to sequentially describe what occurs at each of the remote segments of the C+ lens. Taking the principal ray of the system passing through point 114, in the absence of specialized lens V that impingement would be on point S'. However, and due to the vector deflection towards the centre of the spherical lens C+, there will be incidence upon a point 24.

An analysis of a point diametrically opposite the positive spherical lens C+, can be similarly made. Deflection will occur from the normal impingement S' to a new point 25 on the image plane.

Similarly, for a point 116 on the plate V, a deflection to the point 26 on image plane S will occur. This deflection detouring light that was originally intended for point S'. Finally, and from point 117 on lens C+, imaging occurs at a point 27.

In the case of a negative lens, negative lens C− includes a remote point 115' which point 115' again images at point 25. Similarly, it includes a point 116' and 117' which points again image about point S' as previously described.

It will of course be appreciated at this point with respect to the astigmatic segments of the lens A1 and A2 that only two remaining deflections may be described. Specifically, these deflections are 115'' and 115''' at the respective corners. Light rays at these points will be deflected to point 25.

It will be hereafter seen that what results from the projection of the source S passing through lens L with the specialized lens V substituted therebetween is an evenly distributed square light pattern on the focal plane D. This image on the plane D has a square shape. With movements of S along the X and Y axes, corresponding movement of the square image on plane P will likewise occur.

In Fig. 4 again a source S is movable in an XY plane. Source S has an image on imaging plane P through a lens L. A specialized lens element V causes a deflection pattern with light contained inside a square boundary, as explained in the case of the matrix of four sections.

Lens V is divided into lenses C+, C−, A1 and A2 as previously described, this time in a matrix of well over four such sections. Due to the complexity of the figure, only some of each of the representative lens segments are labeled with the appropriate designations C+, c−, A1 and A2.

Continuing on with the view of Fig. 4 it is noted again that all segments of the lens project light in square patterns. The light falls within a boundary of a square delineated by the points 24–27 as previously described.

Similar to the case previously described, where translation occurs this translation will result in a deflection of the entire square image formed by the boundaries 124–127.

Placement of knife edges at varying alignments across the lens element can be instructive. Turning to Fig. 5, a source S images through a lens L to an imaging plane P. Again, the specialized lens V is interposed this lens having a configuration the same as previously described in Fig. 4. This time, however, a knife edge is placed across the lens, at position K1, forming a limiting aperture through which light from source S can pass through lens V and hence be imaged by lens L on image plane P.

As will hereinafter be more fully set forth, it is required that two conditions be met by a knife edged aperture disposed on the lens V.

First, the edge of the aperture must traverse equal portions of each of the four element types comprising specialized lens V (C+, C−, A_1, A_2).

Secondly, the edge of the aperture must be disposed across the lens V, at an especial slope to the boundaries of the lens elements of the matrix and not parallel to these boundaries.

A particularly preferred slope is 2:1, as shown in Fig. 5. Every time the illustrated knife edges traverse two elements disposed in the horizontal direction, the knife edges traverse one element disposed in the vertical direction. Other special slopes, designed a b, will also obtain the desired effect if and only if a is odd, when be is even, or b is odd when a is even, where a and b are whole numbers.

Knife edge K1 passes through point 135 on lens A1 and point 136 on lens C−. It is known from the example of Fig. 3 that at these two points, that it will image at respective points 125, 126 on image plane P. The question then becomes where will imaging occur medially for light rays passing between points 135 and 136, say at point 140. Realizing that point 140 is the peripheral edge of a negative cylindrical lens C−, the problem is simplified. Specifically, it can quickly be seen that a full negative deflection will be to the periphery of the square at a point 150. Thus, taking the case of parallel rays passing sequentially across a knife edge from the point 135 to the point 136, it will be quickly seen that the light rays will image along a line 125, 150, 126.

Taking the case of knife edge K2 and passing from left to right the deflection may be understood by superimposing thereon a similar vectorial analysis. Starting at point

141 on the left hand edge of knife edge K2, it will be remembered that we are in the middle of a positive spherical segment C+. Deflections will be vectorially distributed towards the neutral portion of the element. Impingement of light at point 151 will result. Taking light incident upon knife edge K2 and point 142, it will be seen that this point is at the upper segment of a positive spherical lens. Deflection will therefore be downwardly and to the neutral point of the lens with resultant impingement of the light at a point 152.

At point 143, the light will impinge upon at a boundary between the two lens elements, the boundary here being that of a fully negative lens, C −. This fully negative lens will cause light incident at the point to be incident at point 153.

At point 144, it will be noted that knife edge K2 passes through the neutral portion of a negative lens. Consequently, and in passing through the neutral portion, it will be incident upon the centre of the square at the point S'. Finally, and in passing point 155, light will be incident on the edge of the square at 155. There results the shown traced zig zag pattern of traced K2'.

We now for purposes of instruction trace the path of ray grazing knife edge K3 as it passes through the element. We note that knife edge K3 begins at point 146. Point 146 is a section of a positive spherical lens C + and projects to point 156 on image plane P.

At point 147 we note that the light ray is at a corner of a positive spherical lens C + and a negative spherical lens C −. Light projected from point 147 following the same logic as in Fig. 5 ends up point 127 on plane P. Light from point 148 plots similarly. This light at a periphery of a negative lens element ends up at point 158. Thereafter, light from point 159 deflects to point 159.

Having traced knife edges K1, K2 and K3, there remains the problem of tracing a more complex array in a similar manner. This has been illustrated with respect to the schematic plots of Figs. 6 and 7.

Referring to Fig. 6 it is instructive to illustrate deflections of knife edges disposed along Fig. 6 on the square image trace of Fig. 7. Here, the observer will note that the light source S and the lens L have been omitted. All we are now going to view is the knife edge as it is disposed across the lens element V shown on Fig. 8A and the resultant traced pattern as it appears in Fig. 8B.

Taking a knife edge defined by the points 180, 181, 182, 183 and 184, the trace can be rapidly generated. Taking point 180, it is observed that this point is at the edge of a positive spherical lens. Remembering that in the absence of plate V it would have been deflected to the centre of the diagram at point 195 and remembering also that it is given a vectorial deflection by the lens element along the diagonal direction, it can be seen immediately that it arrives at point 194. Taking point 181 along the knife edge, 181 will be seen to be a portion at the edge of a negative cylindrical lens. This point is horizontally located from a neutral segment of a negative lens C −. Accordingly, the lens ray will be incident at a point 191. By the same logic, light rays intermediate point 190 and 191 will fall along a straight line connecting points 190, 191.

Light from point 182 will project to the upper righthand corner at point 192. Remembering that it would originally have been directed at point 195 and remembering also that it is at an edge of a lens C +, it will be directed to the upper righthand corner of the diagram.

Light from point 183 will be incident upon the same point as light from point 181. Remembering that light at point 183 is on the edge of a positive spherical lens and that the positive sphere is directed to the left, deflection will be to the boundary on the left.

Finally, light from point 184 will project to point 194 which is coincident to previously alloted point 190.

Thus, light along a knife edge intersecting the diagonal points of the lens always plots as a V.

It is interesting now to investigate light which passes through neutral points of the segments of the specialized lens V. This has been plotted along the line which runs 186, 188, 185, 189, 187, 188, 189.

First, the case of light at points 185 can be easily demonstrated. In that case, we know that the light will in no way be deflected. No deflection will result at impingement of point 195.

Light incident on the lens of Fig. 6 at point 186 falls on the edge of a positive spherical lens. Falling on that edge, it must be deflected to point 196 on Fig. 7.

Likewise, light incident at 188 falls on the edge of a negative spherical lens. This negative spherical lens plots out at point 198 on the diagram of Fig. 7. Similarly, light at point 189 falls on the opposite edge of a negative lens. This light plots out at point 199 after passing through the neutral point 195 of the lens. Thus, as the knife edge traverses the negative C −, we get a linear deflection from points 198 to 195 and finally to point 199. At point 187 we are at the edge of a positive spherical lens. This will deflect to point 197 as illustrated in Fig. 7. Light at point 188' will be at the edge of a positive spherical lens. This will plot out at point 198'. The traverse of the knife edge from point 188' to point 189' must pass through a neutral segment of the lens at 195. It will be found that point 188' plots on the lefthand edge of 198' and point 189' plots at the righthand edge at

199'. Thus a pattern results that almost looks like a Fig. 8 drawn with straight lines that repeats upon itself. It is not unlike a Lissajous pattern drawn with straight lines.

Fig. 7 is a written on a background. This back-ground includes horizontal axes X and vertical axes Y. The figure projects along boundaries 100, 101, 102, 103 (labeled clockwise).

Each of the lines traces into respective quadrants of these figures. These quadrants themselves can be labeled quadrant 104, 105, 106, 107.

An interesting observation can be made. The length of line resultant from the projections of the knife edge in each of the quadrants is equal. It is equal in linear length. It is also equal in the centre of gravity sense. Specifically, it will be found that the centre of gravity of the line segments in all portions of the images falls symmetrically about point 195.

Fig. 8 is a diagram of the matrix of Fig. 7 superimposed upon a detector. The detector includes photo-discrete quadrants D_1, D_2, D_3 and D_4. Each of these quadrants has approximately the same area as the boundary square which includes the deflection patterns produced by the respective knife edges. At this point, it will be seen that the image in Fig. 8 has been moved along a diagonal 110 to the upper left. As previously illustrated, the detector segments are photodiscrete or separate along lines of division 114, 115.

In order to measure a deflection of the image on a proportionate basis, it is necessary that the amount of line cut from a given knife edge always be proportionately distributed in each of the detector segments D_1–D_4. This proportionate distribution should be equal to the direction and amount of displacement which has occurred. Therefore, where a displacement is along and parallel to a diagonal 110, respective detector segments D_1 and D_3 should have equal amounts of light incident upon them. There should be no difference in signal registered between them to indicate a displacement other than along diagonal 110.

In Fig. 8 the trace of the knife edge or point 180, 181, 182, 183, 184 has been generated. This trace plots is given the same numeric designation.

It can be demonstrated and is indeed apparent from a visual inspection of the drawing, that the linear length of light line appearing in detector segments D_1 and D_3 is equal. The linear length of light line appearing in segments D_2 and D_4 is not equal. The difference is proportional to the displacement as it is occurred along the diagonal 110. Plot of the knife edge designated by points 186, 188, 185, 189, 187, 188', 185, 189' yields the same results, and it will be found that the amount of line residing in detector segments D_1 and D_3 is the same. The amount of light line remaining in detector segments D_2 and D_4 however is again different and by the same amount as before.

Displacement along the opposite diagonal 111 will yield a similar result. Moreover, displacements on any direction follow the above rule. The difference in the amount of light line that is laid down between any opposite quadrants will be proportionate to the displacement. It is this result which allows the application of this detector for the detection of low level light source with photodiscrete detector segments.

It will be seen that the centre of gravity 195, or S' will thus be tracked in its displacement according to the difference in amount of light received at each of the detector segments. It is therefore possible to get a linear output.

Putting an infinite number of knife edges or narrow bands of light across the lens elements, it will be immediately realized that the result will be a solid, evenly distributed patch of light inside a boundary of the same shape as the lens elements. This patch of light will be the conjugate image of every point source of light in a faint and measured image. By utilizing a summation of these conjugate distributed images, each bounded in a square, a peculiarly useful detector image results which incident upon a detector plane will read out X and Y positions for the centre of gravity of a faint and remote image. It is this characteristic of being able to recognize the centre of gravity of a faint image that enables this detector to be peculiary useful.

CLAIMS

1. An optic for deflection of light having an overall optical effect equivalent to: a plurality of optic elements in side-by-side relation, each optic element having a light deflecting interface disposed to one side of said optic and having at least one optically active surface having crossed cylinder optical effects including the composite effect of a first cylinder disposed along a first axis and a second cylinder disposed along a second and intersecting axis.

2. An optic according to Claim 1 which is transparent.

3. An optic according to Claim 1 or Claim 2 wherein said first cyliners are formed on a first side of the optic, and said second cylinders are formed on a second side of the optic.

4. An optic according to Claim 1 or Claim 2 wherein said cylinders are on the same side of the optic.

5. An optic according to Claim 1 or Claim 2 wherein said cylinders are both negative.

6. An optic for the refraction of light to differing destinations comprising in combination an optical surface having a rate of change producing an optical effect equivalent to: a first plurality of optic elements in side by side

relation, each optic element having means for dispersing light incident thereon equally to and over an area of dispersion whereby light incident upon each said optic element is dispersed in a first central pattern from said optic and whereby light incident upon said optic over a plurality of optic elements in a pattern is dispersed from said optic with repetition of said central pattern having dispersion intensity relative to the placement of an image over the surface of said optic.

7. A transparent optic according to Claim 6 wherein said optic elements comprise side by side negative lens elements in an irregular pattern.

8. An optic according to Claim 6 and wherein said optic elements on said optic are placed in rows and columns.

9. A transparent optic according to Claim 6 wherein said optical elements are in rows and columns and said optical elements include side by side combinations of at least positive spherical lenses, negative spherical lenses, cross cylinder lenses of a first alignment and cross cylinder lenses of a second and different alignment.

10. An optic according to Claim 6 wherein said elements are of varying prismatic power across the surface of said lens.

11. An optic according to Claim 6 and wherein at least some of said elements include paired prism surfaces extending the full width of said optic.

12. A transparent optic according to Claim 6 wherein a first plurality of prism elements crosses said optic on one side thereof along a first axis and a second prism element crosses said optic along the opposite side thereof at a second and intersecting axis.

13. An optic according to Claim 12 wherein said axes are disposed at right angles.

14. An optic comprising in combination an optical surface having a rate of change thereover to generate an optical effect equivalent to: matrices of at least four elements distinctly different optical effects wherein said optical effects include at least one element having positive spherical power; at least one element having negative spherical power and at least one cross cylinder element of a first astigmatic position and at least one element of a cross cylinder power having cross cylinder power normal to the cross cylinder power of said first lens.

15. An optic according to Claim 14 wherein said element is refractive.

16. An optic according to Claim 14 wherein said lens elements are formed by a first series of lens elements comprising side by side positive and negative cylindrical elements and a second series of side by side positive and negative cylindrical lens elements, said first elements substantially normally aligned to said second elements to thereby form individual matrices of optical elements having an optical effect.

17. An optic for the deflection of light substantially as described herein with reference to the accompanying drawings.

18. An objective refractor including an optic according to any preceding Claim.

CLAIMS

Amendments to the claims have been filed, and have the following effect:–

Claims 1 to 18 above have been deleted or textually amended.

New or textually amended claims have been filed as follows:–

1. A transparent optic for the dispersion of light having a surface producing an optical effect equivalent to a plurality of groups each comprising at least four different adjacent optic elements, each element effective to refract light incident thereon from a source differently to and over an area of dispersion, whereby light incident upon each group is dispersed on said area in a specified pattern, and light incident upon the optic is dispersed therefrom with repetition of the pattern and with dispersion intensity relative to the placement of an image over the surface of the optic.

2. An optic according to Claim 1 wherein the optic elements on the optic are placed in rows and columns.

3. An optic according to Claim 1 wherein the optic elements are in rows and columns and the groups of elements include side by side combinations of at least positive spherical lenses, negative spherical lenses, cross cylinder lenses of a first alignment and cross cylinder lenses of a second and different alignment.

4. An optic according to any preceding Claim wherein the optic elements are of varying prismatic power across the surface of the optic.

5. An optic according to any preceding Claim wherein at least some of the elements include paired prism surfaces extending the full width of said optic.

6. An optic according to Claim 1 wherein a first plurality of prism elements crosses the optic on one face thereof along a first axis and a second prism element crosses the optic along the opposite face thereof at a second and intersecting axis.

7. An optic according to Claim 6 wherein said axes are disposed at right angles.

8. A transparent optic for the dispersion of light substantially as described herein with reference to the accompanying drawings.

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